Specifying the design for customer learning in the mixed reality experience

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Abstract. Companies search for new ways of utilizing technologies such as the Mixed Reality (MR) in order to enrich their customer interactions. While more of these MR technologies are emerging to assist customer-employee interactions, there is a strategic choice related to scalability of how to organize these service encounters: face-to-face or digitally over the web. Eventually, the question is how much of these interactions can be automatized with acceptable tradeoffs for the customer experience and business outcomes. This study analyzes the influence of a MR design elements on the outcomes of a customer experience in a use case where the customer learning is focal for the service. The experiment comparing two conditions: face-to-face interactions and remote interactions over the web showed no difference in terms of customer experience and perceived learning. On the other hand, the ease-of-use of the technology as well as the familiarity with the subject and technology effected the customer learning. The results offer implications to both the customer experience management and the MR system design.

Keywords: Customer Experience, Customer Learning, Customer-Employee Interaction, Mixed Reality.

1 Introduction

Customer experience and service design have emerged as key concepts in differentiating from competitors and developing services that better provide additional unique value for the customer (Andreassen et al., 2016). Purchase decisions are not based only on the cognitive and rational reasons, because experiences are important factors in creating emotional bonds between customers and service providers that generate also engagement and customer loyalty (Pullman and Gross, 2004). Companies are required to adopt a new way of thinking the relationships with customers, since customer centricity, understanding the customer context and delivering value to individual customers, forms the core of customer experience management (Lemon and Verhoef, 2016).

Service organizations are increasingly utilizing advanced communication technologies (e.g. Froehle and Roth, 2004). Technological development and changed customer preferences have introduced web-based e-commerce and mobile-based m-commerce as increasingly popular ways of organizing business (Bilgihan et al., 2016). Since customers are facing an increasing supply of digital services, their expectations have tightened for consistently better personalization, enjoyment, ease-of-use, and seamless fit of services as part of their daily lives without the restrictions of time and place (Parise et al., 2016).

Mixed Reality (MR) which refers to blended real and virtual environments (Milgram and Kishino 1994), has offered tools for various fields of business to provide real-life simulations, communication mediums, and experiential marketing and learning platforms (Slater and Sanchez-Vives 2016). While more of these MR technologies are emerging to assist customer-employee interactions, there is a strategic choice related to scalability of how to organize these service encounters: face-to-face or digitally over the web. Eventually, the question is how much of these interactions can be automatized with acceptable tradeoffs for the customer experience and business outcomes.

This study analyzes the influence of the MR design elements on the outcomes of customer experience. The study is conducted as an experiment comparing two conditions: face-to-face interactions and remote interactions over the web. In addition, moderating effects from the previous literature are raised and analyzed: the familiarity with the subject and technology, and the ease-of-use of the technology. The customer experience is analyzed within the framework of customer learning (Li et al. 2003), which is often the objective of the MR service encounter and the system design (Slater and Sanchez-Vives 2016). The results offer implications to both the customer experience management and the MR system design.

2 Customer's virtual experience and learning

Experiences can be seen to form differently in offline environments and online environments. Studies on experiences in online environments have led to the formation of a variety of different concepts, such as web experience (Constantinides, 2004), online customer experience (Rose et al., 2011; Bilgihan et al., 2016), technology-mediated customer experience (Froehle and Roth, 2004), and virtual experience (Li et al., 2001). In this study, we are experimenting two conditions: a technology-mediated customer experience, which is generated by using mixed reality in the context of timber trade and forestry services and where the service employee is present giving face-to-face instructions. The second condition is a virtual experience, where the same application is used while the service employee is giving instructions remotely over the web connection with audio and video.

Virtual experience has been presented as a form of experience alongside with direct and indirect experiences (Li et al., 2003). It is a form of indirect experience, but has some notable differences compared to it, mostly because of the ability of virtual experience to engage multiple senses. Virtual experience has an ability to provide part of the richness of a direct experience while still being an indirect experience.

Elements or dimensions of virtual experience can be divided into three general categories: functional factors, psychological factors and content factors (Constantinides, 2004). The main elements of virtual experience (online experience) include trust, social presence, usability, interactivity, perceived ease-of-use, perceived usefulness, aesthetics, and enjoyment (Constantinides, 2004; Rose et al., 2011; Klaus, 2013; Algharabat, 2014; Bilgihan et al., 2016). Similar features are acknowledged in the definition of virtual experience by Li et al. (2001) defining individual virtual experience as vivid, involving, active, and raising affective psychological states. They also emphasize the importance of presence, involvement and enjoyment in forming the virtual experience.

Several different models have been used to assess how the design elements of virtual reality influence the outcomes of customer experience. SOR-model (stimulus, organism, response) is often used as it describes the process of how the stimulus originated from the service context is processed by an organism and leads to a response (e.g. Kim and Lennon, 2010; Zhang et al., 2015). The focus on stimulus (elements of service design), organism (perceived virtual experience) and response (beliefs, attitudes and intentions) can be found in many of the studies focusing on virtual experiences. Some studies have aimed at pointing out the effects of certain stimulus elements such as user interface (Suh and Lee, 2005; Suh and Chang, 2006) or product type (Suh and Lee, 2005), on the formation of the virtual experience. Others have studied the role of organism characteristics such as user goal (Schlosser, 2003) and technology-readiness (Jahng et al., 2006). In earlier studies, the effects of these factors are often assumed to be mediated by a component of virtual experience, mostly either telepresence (Suh and Lee, 2005; Suh and Chang, 2006) or flow (Javornik, 2016).

Most studies recognize the division of customer responses into three dimensions: cognitive, affective and conative responses (Richardson, 1984). BAI-model (belief, attitude, intention) represents this kind of division of the outcomes of experience into three separate constructs and variables measuring them: beliefs (e.g. information richness, learning about product attributes, usefulness), attitudes (e.g. attitude towards the contact medium, contact episode or the service provider), and intentions (e.g. purchase intention, intention to use medium again, intention to use service provider again) (Froehle and Roth, 2004). Another application of the BAI-model is the customer learning. The customer learning can be divided into cognitive learning, affective learning and conative learning. These dimensions of learning can be measured by product knowledge (cognitive learning), brand attitude (affective learning) and behavioral intentions, such as purchase intention (conative learning) (Li, et al., 2003).

Studies have shown that the virtual experience affects positively product knowledge, brand attitude and purchase intentions compared to indirect experiences (Daughert et al., 2008). There is also a sequential order between these outcomes. Virtual experience, through its component telepresence, has a direct effect on product knowledge and brand attitudes, but the effect on purchase intention is indirect and mediated by brand attitudes (Suh and Chang, 2006). This sequential order highlights the importance of affective responses alongside with cognitive responses in order to influence behavioral responses.

The literature review on previous research shows the research gap: the different effects of the technology-mediated customer experience and the pure virtual experience on the customer experience and learning is unknown. Furthermore, there are multiple customer virtual experience moderating effects raised by the previous literature, which are not specifically studied in the field of the customer learning. Better understanding of these issues is crucial when designing the emerging MR service encounters which are inherently concentrating on the customer learning (Slater and Sanchez-Vives 2016). Furthermore, the study results will have implications on the automatizing of these services.

3 Research framework and hypotheses

We adopt the SOR-model as the research framework, where the customer experience and the outcomes are considered to result from a three-staged process including stimulus, organism and response. In terms of stimulus, we compare the effect of the technology-mediated customer experience and the pure virtual experience. In terms of MR experience interactions, from now on, the technology-mediated customer experience will be addressed as "face-to-face" and the pure virtual experience as "remote". We consider organisms such as customers' familiarity with the technology and subject as well as perceived ease-of-use of the technology. Responses are categorized following the categorization of the customer learning named product knowledge (cognitive learning), brand attitude (affective learning), and intentions (conative learning) (Li et al. 2003), where the sequential order between these outcomes is recognized as described in the previous research (Daugherty et al., 2008; Suh and Chang 2006).

Interaction provides opportunities for the company to become a part of customer´s activities and thus influence the creation of customer experience and value-in-use, as well as outcomes of the service encounter (Grönroos, 2011). In addition, the personal and emotional connections that service personnel form have an important role in creating customer experiences and affect the customer responses to those experiences (Zomerdijk and Voss, 2010).

MR interfaces can enhance the learning of the customer by increasing both perceived and actual product knowledge compared to static interfaces (Suh and Lee, 2005). It has been suggested that as MR provides the user an opportunity to explore the virtual environment by using their entire body (embodied interaction), knowledge is brought closer to the user and therefore learning is enhanced (Lindgren et al., 2016).

Social presence is a central concept when the role of another person is analyzed in the formation of customer experience. Social presence is defined as the capability of a communication medium to enable user to experience other people as being present (Gefen and Straub, 2004). Social presence has positive influence on trust, enjoyment and perceived usefulness (Cyr et al., 2007).

In terms of the customer-employee interaction effect on customer experience and learning, the previous research suggests that face-to-face / remote interactions are complementary i.e. those questions that cannot be solved remotely are completed in presence (Köhler et al. 2011). Based on the previous research on customer-employee interactions and the positive effect on customer experience and learning we draw our first hypothesis:

Hypothesis 1: The face-to-face interaction has a positive impact on the customer experience and learning over the remote interaction.

The virtual experience and the object interactivity creates more vivid mental images than traditional passive contents (Schlosser, 2003; Lee, 2012). Mental images are in an important role in customer learning. Thus, customers with little previous knowledge and weak mental images, will especially benefit from mental imagery enhanced by object interactivity (Schlosser, 2003). Also, the role of the product or service in customer´s life affects their motivation to learn (Nambisan and Baron, 2007). Thus, we propose the following hypothesis:

Hypothesis 2: Customers with little previous knowledge and weak mental images, i.e. familiarity with the subject, have more positive customer experience and enhanced learning.

The familiarity with the technology influences positively perceptions about the experience in the digital service interface as the customer feels more confident about using the technology, and thus it has an important role in online decision-making and purchases (Hernández et al., 2010). Lorenzo et al. (2007) studied the role of the familiarity with online services on online decision-making and observed that the number of years the customer has used the Internet (familiarity with technology) had a significant role in the online shopping process, but the actual familiarity with the subject, i.e. the online shopping (familiarity with process), was not as important.

Hypothesis 3: The familiarity with the technology has a positive impact on the customer experience and learning.

Hernández et al. (2010), in turn, suggest that the effect of familiarity with technology has more important role with the new emerging technologies, while the significance decreases as the technology becomes more conventional and people have learned how to use them. Similarly, the ease-of-use of the technology is emphasized for new users, while different utilities become more important for experienced users (Hernández et al. 2010).

Hypothesis 4: The ease-of-use of the technology has a positive impact on customer experience and learning.

4 Data and method

This study followed true experimental research design, in which research subjects are randomly assigned to treatment groups (Malhotra and Birks, 2003). In the face-to-face condition, the service employee was physically present in the same room and it simulates a corner store customer-employee encounter. In the remote interaction, the service employee was digitally present via a Skype connection representing a digital or distant customer-employee encounter. The main idea of the experimental design is to randomly assign research subjects to an experimental and a control group, provide a treatment to the experiential group, and compare the outcomes on a dependent variable between the two groups (Vogt, 2007).

The participants were recruited via an email invitation to participate to the experiment at the firm’s service and sales point and at a forest fair. Each test lasted for 30 minutes that included the use of the application and answering the survey. The physical setup of the application included a computer, a HTC Vive headset (fully-immersive head-mounted display, HDM), two controllers, a screen (for service employee/observer), and virtual forest application. The content of the application was focused on demonstrating various forest management operations and teaching about them. Based on the literature and the theory frame, we develop a scale measuring the effect of the MR experience interactions, customer's familiarity with the technology and subject, and ease-of-use of the technology on the customer learning as the dependent variables (Table 1).

Table 1. The initial scale.

Independent variables
MR interaction face-to-face / remote (Experiment, Nominal)
MR familiarity (Nominal-scale 1-3)
Easy-of-use of the technology (Nominal-scale 1-3)
Subject familiarity (Nominal-scale 1-3)
Dependent variables (Likert-scale 1-5)
Product knowledge (cognitive learning):
This kind of system would help in managing forest estate (Attention)
In my opinion, the modelled forest seemed real (Association)
In my opinion, the timber prices were reliable (Evaluation)
I learned new things on forest management (Information seeking)
I could actually apply those things that I learned on forest management (Questioning of product attributes)
Brand attitude (affective learning):
In my opinion, the digital services of X offer a good user experience (Overall perception)
In my opinion, the digital services of X are better than other similar ones (Comparative perception)
I believe that X will offer the best digital services in the future (Long-term future perception)
Intentions (conative learning):
I will be in contact with forest specialist after this experience (Interaction)
I can recommend the use of this kind of service to a friend (Interaction)
I am interested in participating in testing a similar service again (Interest)
I am ready to buy a virtual forest management plan on my own forest (Action)
Based on this experience, I am ready to sell wood (Action)

All the dependent variables were measured using 5-staged Likert-scale (1=strongly disagree; 5=strongly agree). Product knowledge (cognitive learning) was measured using a scale suggested by Li et al. (2001): product attribute attention, product attribute evaluation, product attribute association, questioning of product attributes and information seeking. Brand attitude (affective learning) was measured by using a scale for corporate reputation by Lai et al. (2010). The questions covered customer´s overall perception ("In my opinion, the digital services of X provide a good user experience"), comparative perception ("In my opinion, the digital services of X are better than other similar ones"), and long-term future perception ("I believe that X will offer the best digital services in the future”). Here the company name is replaced with X. In terms of intentions (conative learning), we follow the suitable customer activities introduce by Kotler et al. 2006: interaction, interest and action.

In terms of independent variables, the scales were nominal as presented in the Table 1. The “VR familiarity” was surveyed with the scale (unfamiliar with MR, somewhat familiar with MR, very familiar with MR), the “ease-of-use of the technology” with the scale (easy to use, neutral to use, difficult to use) and the “subject familiarity” with the scale (very familiar with the subject, somewhat familiar with the subject, not familiar with the subject).

The Kaiser-Meyer-Olkin measure of sampling adequacy (0.773) and the Barlett´s test of sphericity ($p<0.0001$) indicated that the sample was suitable for factor analysis (e.g. Metsämuuronen 2009). An exploratory factor analysis (maximum likelihood factoring) with Varimax rotation was employed (see, e.g. Hair et al. 1998). Factor eigenvalues and explanatory power of the total variance together with Cronbach’s alphas were also computed for each factor in the reliability analysis. The homogeneity of variance test indicated uneven variances between the data from specific groups, hence the non-parametric analysis of variance -tests were applied. Mann-Whitney U-test was used for independent variables with two groups, and Kruskal-Wallis one-way analysis of variance was used for independent variables with more than two groups. Both tests use the ranks of the data to see whether the independent samples come from a population with the same distribution (Singh, 2007). Significance level of 0.05 was used as cut-off value for significance.

5 Results

Altogether 64 people participated the experiment, out which 37 (58%) were assigned to the face-to-face and 27 (42%) to the remote condition. Other independent variable were distributed as follows: 29 (45%) unfamiliar with MR, 26 (41%) somewhat familiar with MR, 9 (14%) very familiar with MR; 38 (59%) easy to use, 12 (19%) neutral to use, 14 (22%) difficult to use; 11 (17%) very familiar with the subject, 33 (52%) somewhat familiar with the subject, 7 (11%) not familiar with the subject.

In terms of the dependent variables, the perceptions about how well the virtual forest represents real forest were almost equally divided among the participants with 56% strongly or somewhat agreeing with the statement “The forest seemed real” ($M=3.61$) and 44% strongly or somewhat agreeing that the prices of wood were believable ($M=3.45$). However, almost half of the participants neither agreed nor disagreed with the prices of wood. Majority (82%) of the participants agreed that the virtual forest would be a useful tool for managing forest property ($M=4.14$). Learning about forest management when using the virtual forest ($M=2.48$) and utilizing the learned things ($M=2.66$) were perceived low by half of the participants. However, 24% of the participants strongly or somewhat agreed with the statement “I learned something new about forest management.

Majority of the participants agreed that the digital services of the firm X provide a good user experience (M=3.94). Comparing the digital services of the firm X to other similar ones was perceived challenging as 55% did not take a stand on brand question 2 (M=3.44). Majority of the participants agreed that the firm X will have the best digital services in the future (M=3.89).

Majority (89%) of the participants were interested in participating in testing similar service again (M=4.50) and 83% was willing to recommend service to a friend (M=4.25). Almost half of the participants were ready to buy virtual forest management plan of their own forest (M=3.27) and ready to sell wood based on the experience (M=3.33). Intention to be in contact with forestry specialist after the experience was divided between 34% of participants strongly or somewhat agreeing and 38% strongly or somewhat disagreeing with the statement “I will probably be in contact with the forest specialist after this” (M=2.94).

In the factor analysis, the item “Prices of wood were believable” was removed due to the low communality value (<0.25). The item “Based on this experience, I am ready to sell wood” suffered from cross-loadings, thus it was also removed from the factor solution. The two-factor solution is presented in the Table 2. The first factor comprises all the elements from the customer learning experience –model (Li et al. 2003) e.g. product knowledge (cognitive learning), brand attitude (affective learning) and behavioral intentions (conative learning). Therefore, the first factor is named to present “customer experience”. The first factor explains 46.8% of the variables’ total variation. The Cronbach’s alpha reliability analysis was carried out for the items of the factor showing a satisfactory value of 0.87, which is greater than a threshold value of 0.7. The second factor consists of items such as “I learned something new about the forest management” and “Things I learned I can utilize in managing my own forest”. The second factor was named “perceived learning” as it consisted the conscious learning elements from the customer learning experience –model (Li et al. 2003). The second factor explains 14.1% of the variables’ total variation. The Cronbach’s alpha value was again satisfactory with 0.88. Together, the two-factor model accounted for 60.9% of the variance.

The one-way non-parametric ANOVA (Mann-Whitney) was run for the two-factor solution (Figure 1). There was no statistical differences ($p < 0.05$) between the face-to-face and remote interactions and thus the hypothesis 1 “The face-to-face interaction has a positive impact on the customer experience and learning over the remote interaction” was rejected.

The hypothesis 2 “Customers familiar with the subject have more positive customer experience and enhanced learning” was accepted, but further elaborated according to the results. The ANOVA test (Kruskal–Wallis) showed that customers living close to their real estates (also having strong knowledge and mental image) had lower results in terms of “perceived learning”. The same thing was found out for the customers in the other extreme living far from their forest estates and thus having weak or no previous knowledge or mental image on their forests. The customers living in the mid-range from their forests and in this regard having “little previous knowledge and weak mental images” had the highest positive score for the “perceived learning”. The results suggest the acceptance of the hypothesis 2, while it should be noted that the customers with the strong previous knowledge and mental image and customers with no previous knowledge and mental image are not going to have similar positive learning experience. The familiarity with the subject and the factor "customer experience" had no statistical significance in the test.

Table 2. The two-dimensional structure of the factor analysis

Variable/Item	Factor 1	Factor 2
I can recommend the use of this kind of service to a friend	0.807	
In my opinion, the digital services of X offer a good user experience	0.707	
In my opinion, the modelled forest seemed real	0.640	
I will be in contact with forest specialist after this experience	0.639	
In my opinion, the digital services of X are better than other similar ones	0.571	
This kind of system would help in managing forest estate	0.566	
I am interested in participating in testing a similar service again	0.548	
I am ready to buy a virtual forest management plan on my own forest	0.544	
I believe that X will offer the best digital services in the future	0.540	
I learned new things on forest management		0.897
I could actually apply those things that I learned on forest management		0.878
Eigenvalue	5.15	1.55
Explained variance%	46.8	14.1
Cronbach's alpha	0.87	0.88

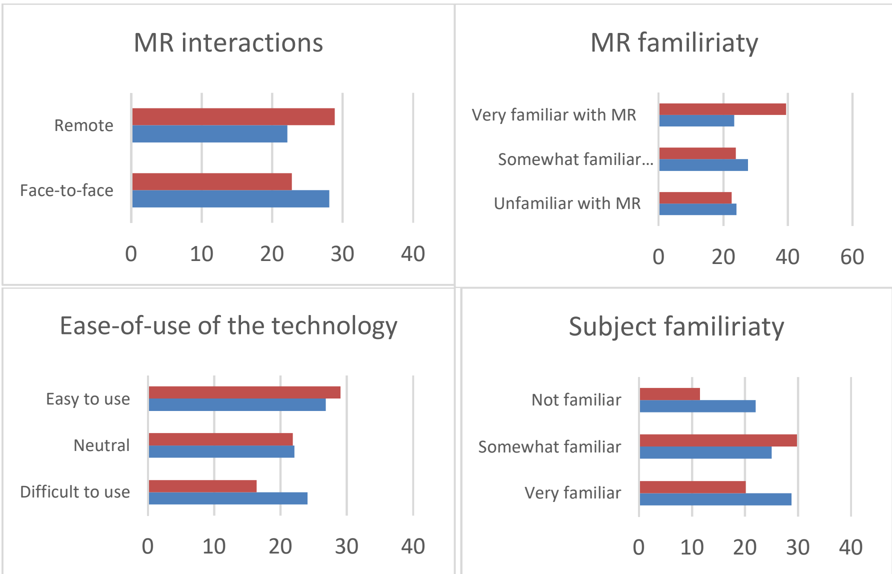

Fig. 1. Differences within dependent variable groups toward the two-factor dimensions. Factor score means ranks on the axes. (Red tile: Perceived learning; Blue tile: Customer experience)

In terms of the hypothesis 3 “The familiarity with the technology has a positive impact on the customer experience and learning” was partly accepted/rejected. The factor “customer experience” and the user’s familiarity with the technology had no statistical significance in the ANOVA test (Kruskal–Wallis), while the factor “perceived learning” was statistically and significantly higher for those who were more experienced with the technology. Therefore, the results suggest that no matter how experienced the customers are with the technology they can all enjoy and benefit from an experienced. However, more experienced customers with the technology can also learn more from the experience.

The hypothesis 4 showed similar results than for the hypothesis 3. The factor “customer experience” and the perceived ease-of-use of the technology showed no statistical significance, while the factor “perceived learning” was statistically and significantly higher for those who perceived the technology easy to use. The results suggest that when the technology is easy to use, the customers also perceive to learn better.

6 Discussion and conclusions

While more immersive technologies are emerging to assist the customer-employee interactions, there is a strategic choice question of how to organize these service encounters: face-to-face or remotely over the web? The previous studies have showed the importance of face-to-face social interactions in creation of the customer experience (Zomerdijk and Voss 2010). In addition, the face-to-face communication is considered as very rich communication form, while the remote collaboration and communication lack part of this richness of direct interaction (Palmer 1995). On the other hand, the MR technologies can create high media richness and a sense embodiment bringing the knowledge closer to the user and therefore also learning can be enhanced (Lindgren et al., 2016).

The research task for this study was to assess, whether the social presence (Gefen and Straub, 2004) can be created with the MR technologies. The social presence was simulated within an experimental setup consisting of two different conditions: face-to-face and remote interactions. Our results show that the MR technologies can create equal social presence whether the service is provided face-to-face or remotely over the web. Our results measured the effect of the social presence on the customer experience and learning showing equal results among the both control groups. However, the previous results of Köhler et al. (2011) suggesting that face-to-face / remote interactions are complementary i.e. those questions that cannot be solved remotely are completed in presence (Köhler et al. 2011) could not be validated within this study. Our findings suggest that the area of the questions that can be solved remotely with the MR technology might be broader than expected. While we only measured the customer experience and learning, the results are limited and suggest a broader analysis of values and utilities where the MR technologies can substitute the social presence.

Our study also analyzed the familiarity with the subject as the moderating effect on the customer experience and learning. The previous studies had shown that especially the customers with little previous knowledge and weak mental images can benefit from mental imagery enhanced by the object interactivity (Schlosser, 2003) such as the MR experience (Schlosser, 2003; Lee, 2012; Lindgren et al., 2016). Our results suggest that the customers with little previous knowledge and mental image may benefit the most of MR-experiences when comparing to the groups with either very high or no previous knowledge and mental image. In practice, this can be implemented by using hints such as photographs that help in understanding both context and the level of abstraction that is used when creating an interactive experience such as an MR application. This finding, however, might be context specific to the forest estate visualizations, thus the result might be limited and should be tested with other research contexts as well.

As another moderating effect on the customer experience and learning, the familiarity with the technology and the ease-of-use of the technology were also analyzed. According to the previous literature, the familiarity with the technology positively influences the experience, while the effect decreases when the technology becomes more conventional (Hernández et al. 2010). Similarly, the ease-of-use of the technology is emphasized for new users, while different utilities become more important for experienced users (Hernández et al. 2010). Lorenzo et al. (2007) suggest that the familiarity with the technology is more important over the familiarity with the subject. Our research results could not give any suggestions about the order of importance, but all the moderators including familiarity with the subject and technology as well as the ease-of-use of the technology were meaningful in creating positive learning experience, which is a new finding and a contribution to the customer learning research. Therefore, these factors should be taken into account in the design of customer-employee interactions and related systems. The major limitation of this paper is that it analyzed the perceived learning, not the actual learning results. Considering that and the relative significance of the present and other possible moderating factors on the customer learning is a promising avenue for the future research.

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